VALIDATING THE IS-IMPACT MODEL IN AUSTRALASIAN UNIVERSITIES

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Abstract

This paper presents a novel study that aims to contribute to understanding the phenomenon of Enterprise Systems (ES) evaluation in Australasian universities. The proposed study addresses known limitations of arguably the most significant dependent variable in the Information System (IS) field - IS Success or IS-Impact. This study adopts the IS-Impact measurement model, reported by Gable et al. (2008), as the primary commencing theory-base and applies research extension strategy described by Berthon et al. (2002); extending both theory and the context. This study employs a longitudinal, multi-method research design, with two interrelated phases – exploratory and confirmatory. The exploratory phase aims to investigate the applicability and sufficiency of the IS-Impact dimensions and measures in the new context. The confirmatory phase will gather quantitative data to statistically validate IS-Impact model as a formative index.

Keywords: IS-Impact, IS-Success, IS Evaluation, Formative Construct Validity.

1 INTRODUCTION

The standard tools of contemporary organisational analysis and institutional management are being adopted and applied in the universities context. One of the prominent trends is the adoption of Enterprise Systems (ES)[1] applications (Pollock & Cornford, 2004; Rabaa'i, Bandara, & Gable, 2009). Universities are making significant investments in ES to improve institutional business processes (Mehlinger, 2006). Organisations, including universities, have invested heavily in ES (Gartner, 2009), expecting positive impacts to the organisation (Gable, Sedera, & Chan, 2008). However, organisations often do not experience the performance gains they expect from their information systems (IS) investments (Bergersen, 2004; Seddon, Calvert, & Yang, In Press). Thus, these investments are under increasing scrutiny and pressure to justify their value (Markus, Axline, Petrie, & Tanis, 2003).

Research into the measurement of IS success has been ongoing since the late 1970's (DeLone & McLean, 1992; Gable et al., 2008; Gable, Sedera, & Chan., 2003; Petter, DeLone, & McLean, 2008; Rabaa'i, 2009). However, structured and robust models, that capture the whole IS Success scenario are scarce (DeLone & McLean, 1992; Petter et al., 2008). The scope and approach of these IS Success evaluation studies has varied, and there is little consensus on the appropriate measures of IS Success (Gable et al., 2008). According to (Sabherwal, Jeyaraj, & Chowa, 2006: 1849) "Despite considerable empirical research, results on the relationships among constructs related to information systems (IS) success, as well as the determinants of IS Success, are often inconsistent". This complicates comparisons of results across studies and impedes the establishment of a cumulative research tradition (Sabherwal et al., 2006). The impacts of IS are often indirect and influenced by human, organisational, and environmental factors (Petter et al., 2008). Yet, it is argued "if information systems research is to make a contribution to the world of practice, a well-defined outcome measure (or measures) is essential" (DeLone & McLean, 1992: 61).

Gable et al, (2008), in reference to Gregor's (2006) analytic theory, suggested a reference model or a theoretical framework should have the characteristics of a strong analytic theory, that reflects the qualities of utility, intuitiveness, mutual exclusivity, completeness, and where relevant, appropriate hierarchy. Gable et al. also suggested that, beyond those qualities of analytic theory, a framework of IS Success should maximally reflect the full range of IS impacts and the views of all key internal stakeholder groups.

This research adopts the IS-Impact model, reported by Gable et al. (2008; 2003), as the primary commencing theory-base. The IS-Impact model is conceptualised as a formative, multidimensional index, wherein the dimensions have a causal relationship with the overarching measure – IS-Impact. While the IS-Impact model was rigorously validated in previous research, there is a need to further generalise and validate the model in different contexts; to test the generalisability of the model; whether the model's dimensions and measures remain the same across different organisations and across different applications. Hence; the overall research will include interrelated phases, and employs the extension strategy as described by Berthon et al. (2002), extending both theory and the context; where the new context is different ES application; namely, the Human Resource (HR) application, implemented at Australasian universities.

1.1 Research Objectives

The research proceeds from a central interest in the importance of evaluating IS success in the university context; the rapid, and recent growth of ES market in universities; the lack of scholarly publications discussing ES evaluation in universities; and the relatively little specific attention to causes and measures of ES success/failure in the university context (Rabaa'i et al., 2009). This proposed research will investigate the generalisability of the IS-Impact model, instrument and

[1] Enterprise System (ES) is synonymous herein with the term enterprise resource planning (ERP) see Klaus et al. (2000) for more details.

approach in Australasian universities. Main objectives of this research are: (1) to further test the validity, robustness, and applicability of the IS-Impact model in Australasian universities, (2) to identify relevant new dimensions and measures of the IS-Impact in the university context, (3) to identify relevant key-user groups of ES in Australasian universities, (4) to introduce the IS-Impact measurement model to Australasian Universities, as a reliable and valid model for measuring the success of ES applications, (5) to describe the state of ES in Australasian universities, and (6) to measure the impact of specific ES application (i.e. HR application) Australasian universities.

1.2 Significance for Research

The proposed research addresses known limitations of arguably the most significant dependent variable in the Information System field - IS Success or IS-Impact. The study is novel in aiming to contribute to the goal of validating/testing/generalising a common model, instrument, and approach for measuring IS impact in a holistic way.

1.3 Significance for Practice

According to Swartz and Orgill (2001), some universities spend over $20 million USD to implement these complex software products. Thus, complex and expensive ES are transforming organisations and industries, but not always for the better. Yet, ES investments are seldom systematically evaluated post-implementation, and where assessed, the process and measures are typically idiosyncratic and lacking credibility. Therefore; reliable, valid and comparable indicators of the impacts of IS are required for universities to know how there is investment is performing, to maximise benefits, and to better plan future IS investments.

2 RESEARCH QUESTIONS

The research questions follow Cooper & Emory's top-down approach (1995) which comprises four levels of questions. The hierarchy consists of (1) management level, (2) research level, (3) investigative level, and (4) measurement level[2].

The first level, management level, describes the key research question, or an overarching problem of the research. The key research question for this proposed research is:

"How can the IS-Impact of Enterprise Systems in Australasian Universities be effectively and efficiently measured?"

The research level contains research questions that are derived from the managerial question, providing a general purpose for conducting this study. In this research, there are four research questions.

Research Question 1: **"Who are the relevant key-user groups of enterprise systems in Australasian Universities?"**

This research question is concerned with identifying key-user groups of ES in Australasian universities. Prior research has suggested that there are three levels of key-user groups in the IS context: Strategic, User and Technical (Sedera et al., 2006). The User group is consists of two other sub-groups which are Management and Operational. These three levels of employment cohorts are observed to place different emphasis on the dimensions in the IS-Impact model. Thus, the researcher will test the following two investigative research questions:

Investigative Q1.1: What are the key-user groups of ES in Australasian universities?

[2] Although not discussed in this section, the final level of the hierarchy, Measurement level questions, are derived for the actual set of data to be collected (i.e. questions within surveys and interviews) (Cooper and Emory, 1995).

Investigative Q1.2: Do these key-user groups place different emphasis on the model dimensions in their overall evaluation of ES?

Research Question 2: **"What is the state of enterprise systems in Australasian Universities?"**

This research question is concerned with investigating the state of enterprise systems in Australasian universities. In order to address this question, the researcher will test the following four investigative questions:

Investigative Q2.1: How has the marketplace of enterprise systems for Universities evolved?

Investigative Q2.2: What is the history of enterprise systems in Australasian Universities?

Investigative Q2.3: Who are the main vendors of enterprise systems in the Australasian region?

Investigative Q2.4: What has been the implementation experience of Universities in Australasia with enterprise systems?

Research Question 3: **"Does the IS-Impact model include those dimensions and measures necessary to yield a holistic score on enterprise systems in Australasian Universities?"**

In this question, the researcher seeks to discover whether all the dimensions and measures of the IS-Impact model apply in the universities context. In addition, this question addresses the completeness of the IS-Impact model; in other words the content validity of the model. In order to address this question, two more specific questions are derived:

Investigative Q3.1: Are all existing IS-Impact dimensions and measures applicable in the new context?

Investigative Q3.2: Are any new dimensions or measures required for the new context?

Research Question 4: **"Is the IS-Impact construct valid as immediate antecedent of Satisfaction?"**

In this question, the researcher will further validate the IS-Impact model using new data set gathered from the new context. This validation process will identify IS-Impact through structural relations; employing the Satisfaction construct as immediate consequence of the IS-Impact construct (and the IS-Impact construct as immediate antecedent of the Satisfaction construct) in the IS nomological net (see Figure 2- The conceptual model of the research). More specific questions that will guide in the model validation are:

Investigative Q4.1: What are the reflective measures of the Satisfaction construct?

Investigative Q4.2: Is the relationship between IS-Impact and Satisfaction constructs significant and positive?

Investigative Q4.2: Does IS-Impact explain Satisfaction?

3 ABRIDGED LITERATURE REVIEW

Most early attempts of IS evaluation focused on system availability and performance (Myers, Kappelman, & Prybutok, 1997). Since then, IS performance evaluation has been investigated from three main perspectives - IS effectiveness/success, IS function evaluation and IS service quality (Chang & King, 2005). IS effectiveness/success is the focus of this research. According to Myers et al. (1997, p: 7), IS effectiveness is "concerned about the impact of the information provided in helping users do their jobs". Furthermore, Thong et al. (1994, p: 214) defined IS effectiveness as "the extent to which an information system actually contributes to achieving organisational goals".

IS researchers have come up with variety of measures to help organisations in justifying the value and contribution of the IS investment to the productivity, quality and competitiveness of organisations

(DeLone and McLean 1992, Myers et al., 1997). Basically, there are two types of research in IS success (Ifinedo, 2006). The first employs perceptual, attitudinal or subjective measures; for example, User Satisfaction that was introduced by Bailey & Person (1983) and Perceived Usefulness by Davis (1989). The second type focuses on financial or objective measures such as Return on Investment (ROI) and Cost Savings (e.g. Nicolaou, Stratopoulos, & Dehning, 2003). However, many researchers argue that using financial or so-called objective measures alone is inappropriate (Wu & Wang, 2007), as contemporary IS such as ES provide both tangible and substantial intangible benefits. These intangible benefits are difficult to quantify making 'objective' measurement inappropriate (Wu & Wang, 2007).

With a wide variety of measures, IS researchers face difficulty in choosing the best measures of IS success (Rai, Lang, & Welker, 2002). Furthermore; many studies have focused on various aspects of IS success and very few studies discuss the rationale for their selection of measures (DeLone and McLean, 1992). These issues have caused difficulty in comparing empirical results between IS studies (Sabherwal et al., 2006). In the quest to identify the dependent variable for IS success, DeLone and McLean (1992) have introduced a comprehensive model, known as IS Success model, that contains six interrelated dimensions: System Quality, Information Quality, IS Use, User Satisfaction, Individual Impact and Organisation Impact. Since its introduction, IS success model has gained wide acceptance by many IS researchers (Heo & Han, 2003), with several proposing modifications to the model (Stacie & McLean, 2009). One such study used IS success model as the basis for developing a new measurement model is the work of Gable et al. (2003, 2008).

DeLone and McLean (1992) from the outset encouraged IS researchers to "systematically combine individual measures of IS success categories to create a comprehensive measurement instrument" (p. 87-88). They also suggested the need for consistent and appropriate measures to evaluate IS success. However, in recent literature, Petter et al. (2008) caution IS researchers to carefully understand the IS and the organisation under study before applying the IS success model. They argue that the selection of measures depends on the nature of the systems being evaluated. This argument may suggest that a standard model that can be used across different types of applications or different types of organisation may not be possible. Further investigation on how a model performs in different context should be conducted (e.g. Rai et al., 2002). There were also arguments on how to measure IS from the perspective of stakeholders. Seddon et al. (1999) argue that different individuals are likely to evaluate IS success, therefore they suggest different measures should be used for different stakeholder. Sedera et al. (2006) found, based on statistical evidence, different employment cohorts place different emphasis on the constructs of the IS-Impact model. However, they believe in order to achieve a holistic view on the IS, a complete set of measures from all perspectives is required.

In summary, the scope and approach of IS success studies have varied much. A variety of measures have been introduced by IS researchers to evaluate IS success. IS evaluation studies have used both subjective and objective measures and have employed a diversity of methodologies such as case studies and surveys. These studies too have varied greatly in terms of research paradigm, scope, assessment level, context, perspective, and data collection approach. In terms of research paradigm, for example, some researchers used the positivist approach (e.g. Gable et al., 2003; 2008) and others used an interpretive approach (e.g. Skok & Legge, 2002). As a result, there is little consensus among IS researchers and practitioners on how best to measure the impact of IS in organisations (Gable et al., 2008). ". This complicates comparisons of results across studies and impedes the establishment of a cumulative research tradition (Sabherwal et al., 2006).

4 THEORITICAL FRAMEWORK

Gable et al. (2008) introduced the IS-Impact model to measure IS success/impact (see also Gable et al. (2003)). Gable et al. (2008: 381) define the IS-impact of an Information System (IS) as *"a measure at a point in time, of the stream of net benefits from the IS, to date and anticipated, as perceived by all key-user groups"*. Figure 1 depicts the IS-Impact Measurement Model.

The IS-Impact model, which is based in DeLone and McLean's (1992) work, overcomes many concerns with past IS Success models. Gable *et al.*(2003) pointed out that the IS-Impact Model

deviates from the traditional DeLone and McLean model in the following ways: (1) it depicts a measurement model and does not purport a causal/process model of success, (2) it omits the use construct, (3) satisfaction is treated as an overall measure of success, rather than as a dimension of success, (4) new measures were added to reflect the contemporary IS context and organisational characteristics, and (5) it includes additional measures to probe a more holistic organisational impacts construct.

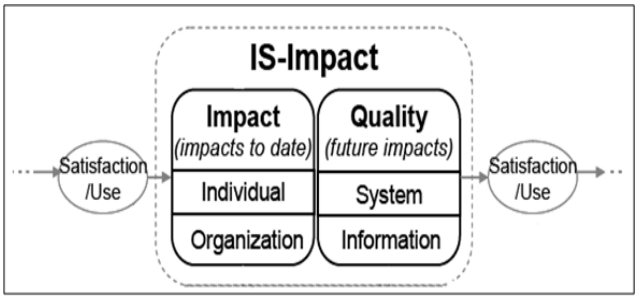

Figure 1. The IS-Impact Model

The complex, multi-dimensional nature of IS success is represented by four constructs and 37 measures. The four-dimensional IS-Impact measurement model consists of two halves; the "impact" half includes Organisational-Impact and Individual-Impact constructs' "*The IS-Impact Model is a holistic index representing the stream of net benefits; the 'impact' half measuring net benefits to date, while the 'quality' half, forms our" best" proxy measure of probable future impacts, with 'impacts' being the common denominator*" (Gable et al., 2008: 381). According to Gable et al, (2008: 389-390), Individual Impact is a measure of the extent to which (the IS) has influenced the capabilities and effectiveness, on behalf of the organisation, of key-users; Organisational Impact is a measure of the extent to which (the IS) has promoted improvement in organisational results and capabilities Information Quality is a measure of the quality of (the IS) outputs- namely, the quality of the information the system produces in reports and on-screen; and System Quality is a measure of the performance of (the IS) from a technical and design perspective.

As mentioned earlier, this research adopts the IS-Impact model as the theoretical foundation of this research. The IS-Impact model, by design, is intended to be robust, simple and generalisable, to yield results that are comparable across time, stakeholders, different systems and system contexts. The model and measurement approach employ perceptual measures and offer an instrument that is relevant to all key stakeholder groups.

5 APPROACH AND METHODOLOGY

5.1 Conceptual Model

The initial study model, developed in the first phase of the study, is depicted in Figure 2. This simple conceptual model incorporates the IS-Impact model to predict key-user groups' satisfaction with the IS. The IS-Impact model includes four dimensions in two halves, representing '*the stream of net benefits from an Information System to date and anticipated as perceived by all key-user groups*' (Gable et al. 2008). The 'impact' half measures benefits to date, or Individual-Impact and Organisational-Impact. The 'quality' half, uses System-Quality and Information-Quality as proxy measures of probable future impacts. In the conceptual model, Satisfaction is the immediate consequence of the IS-Impact.

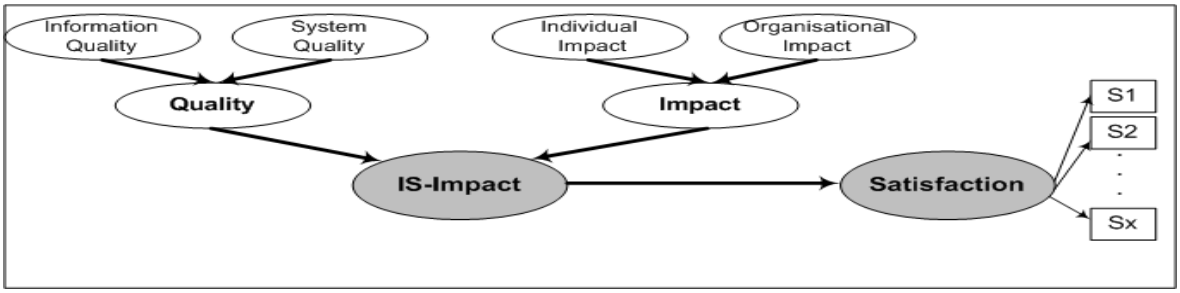

Figure 2. The Conceptual Model

5.2 Research Strategy

This research employs the 'context extension' strategy as suggested by Berthon et al. (2002). Extending the approach and theory used by previous researcher to test and evaluate the general applicability of the measurement model in the new context. The importance of such strategy (theory and context extension) is that it discovers whether theories explain a phenomenon in one context can effectively explain it in another context. It also tests whether a method work in one context can efficiently work another context. The aim is to yield a robust, standard, simple, yet generalisable, instrument for measuring IS success.

5.3 Research Design

This research employs a longitudinal, multi-method research design, extending the research cycle proposed by MacKenzie & House (1979) and McGrath (1979) for developing and validating a measurement model. The overall research design id depicted in Figure 3 presents. As can be seen, this research is divided into three main phases, including: Definition Phase, Model Validation Phase, and Write-up Phase.

The purpose of the Definition Phase is to generate a ground understanding of this area of research that will lead to research problem identification. Additionally, this phase will investigate the research context (the research setting) to explore and describe the organisations (i.e. Australasian universities) and the IS (i.e. ES applications) under study. The main issue the researcher will address through the context research is "The state of ES in Australasian universities"; paying closer attention to how these universities evaluate their ES applications. A context report will be produced at the end of this phase to aid the researcher in informing the research design, in finalising the model to be tested, and in the interpretation. The Definition Phase also includes a case study; with the objective of developing a grounded understanding of ES in the universities context, a single *descriptive* case study was conducted of a Queensland, Australia based university – Queensland University of Technology (QUT) (see Rabaa'i et al., 2009). The use of a single case study here *is neither to generalise nor to test a theory*. Rather, the case study was conducted with the aim of *description*. Descriptive case studies are generally used to provide the researcher with a rich description of the phenomenon being studied (Yin, 2003).

The Model Validation Phase entails two main phases and two surveys: (1) an exploratory-phase, to develop the hypothesised measurement model, and (2) a confirmatory-phase, to test the hypothesised measurement model against new data gathered. The exploratory phase, adheres with the two-step approach of (Burton-Jones & Straub, 2006) for operationalising constructs and identifying measures, aims to adequately account for the context of IS success, and to ensure model completeness and an appropriate and complete choice of measures and dimensions.

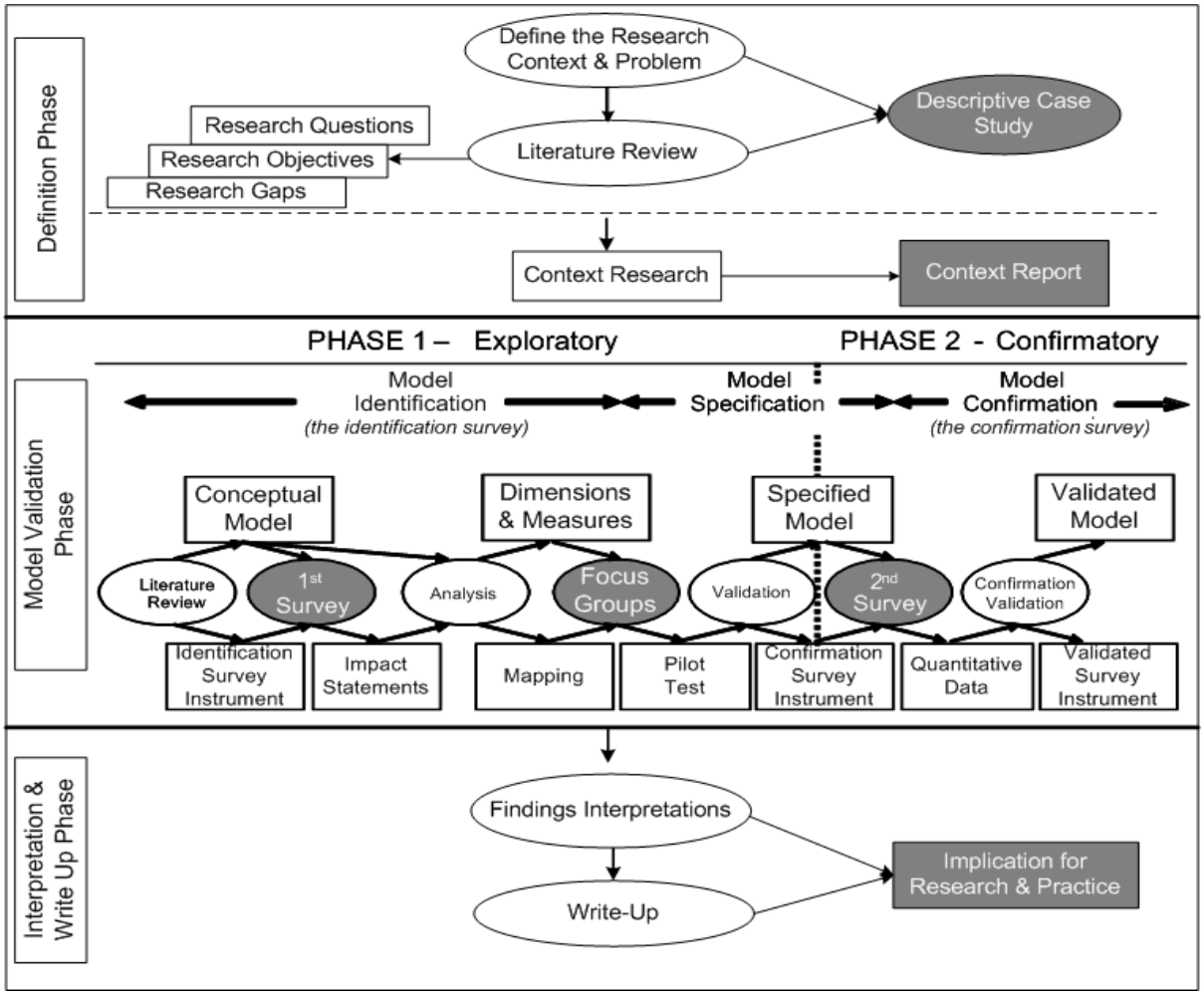

Figure 3. The Overall Research Design

The exploratory phase consists of two-phase approach, the identification survey (1st Survey) followed by a series of Focus Groups. *The Identification survey (the 1st survey)*, akin to the 'function' phase of the Burton-Jones & Straub (2006) approach, is intended to test the completeness and the applicability of the IS-Impact dimensions and measures in the new context. Herein, the study attempts to identify possible new dimensions and measures that have not been captured in the IS-Impact model. Next, the gathered dimensions and measures will be synthesised using the *citation mapping* exercise employing the characteristics of *Analytic Theory* proposed by Gregor (2006). *The Focus Groups* aim to further specify and pilot test the model. The proposed focus groups will be conducted with academics, who are familiar with the research topic, and with senior ae well as middle managers. The dimensions and measures substantiated and discovered in the identification survey phase, pilot tested and specified through the focus groups; will later become the basis of an a-priori model (the modified version of the IS-Impact model in the new context) to be operationalised in the confirmation-survey.

In the confirmatory phase; *The Confirmation-survey (the 2nd Survey)* aims to further validate the model and instrument deriving from the exploratory-phase, and to further illustrate the mutual exclusivity and additivity of the dimensions and measures in the model using confirmatory data analysis techniques and new data. In order to establish internal validity for a "formative index", the researcher will follow guidelines by Gable et al. (2008), Gable and Sedera (2009), and Cenfetelli & Bassellier (2009). The researcher will also follow Jarvis et al.'s (2003) procedures for achieving identification of formative indicators.

The interpretation and write-up phase aims to revisit the research questions and objectives, interpret the results, writing-up the entire research, and drawing conclusions.

6 SUMMARY, CURRENT STAGE, AND OUTLOOK

This paper presented a novel study that aims to contribute to understanding the phenomenon of Enterprise Systems (ES) evaluation in Australasian universities. The study addresses known limitations of arguably the most significant dependent variable in the Information Systems (IS) field - IS Success or IS-Impact. The study background, objectives and significance were presented in the introduction. Section two described the research questions. The paper then provided a brief literature review summarising the nature of studies conducted in the IS evaluation arena followed by the theoretical framework. The next section discussed the research approach and methodology presenting the research conceptual model, strategy and design.

At present, the definition phase of this study has been completed, examining relevant issues relating to IS Success/Impact. An evaluation has been made of current challenges in relation to construct measurement and validation in research. This has incorporated a literature review supported by a conceptual analysis (see Rabaa'i & Gable, 2009). The case study and context report were also completed (see Rabaa'i et al., 2009). The identification survey (1st survey) was conducted at Queensland University of Technology (QUT, www.qut.edu.au) in relation to the university's human resource system (ALESCO). The data analysis of the identification survey along with the focus groups were completed and the a-priori model was developed.

At current, the confirmation survey (2nd survey) was designed to operationalise the dimensions and measures of the a-priori model (developed based on the 1st survey and focus groups findings and discussions). The wording of each item was carefully designed to insure all items are answerable by all key-user groups. QUT has granted the candidate all required approvals to conduct the 2nd (confirmations) survey therein. The next step in this research is to conduct a pilot test of the 2nd survey. The data collection for the 2nd survey will commence on June, 2010 and expected to be completed by June of the same year.

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